polymer (β), wherein the weight average molecular weights of the polymers (α) and (β) satisfy the following equations (III) and (IV):

$$Mw(\alpha) / Mw(a) < 1.2 \qquad \text{(III)}$$

$$Mw(\beta) / Mw(b) < 1.2 \qquad \text{(IV)}$$

wherein Mw(α): weight average molecular weight of polymer (α),

Mw(β): weight average molecular weight of polymer (β),

Mw(a): weight average molecular weight of block (a) of block copolymer, and

Mw(b): weight average molecular weight of block (b) of block copolymer.

REMARKS

Claims 1-17 are pending. Claims 1-17 are rejected. Claims 1 and 14 are amended. The amendments are fully supported by the application, for instance in the claims as originally filed. No new matter is added. Claims 1-17 are submitted for further consideration at this time. Applicants respectfully request reconsideration and withdrawal of all rejections in light of the amendments and remarks below.

Claim Rejections - 35 U.S.C. §112, second paragraph

Claims 1-17 are rejected as being indefinite. It is alleged that the quantity $Mw_{30}(A)$ is undefined, and that the definition of $Mw_{30}(a)$ is unclear in that no determination by GPC is possible since (a) is a block and the blocks are attached to each other. With respect to claim 14, it is alleged that the claim is contradictory in reciting that polymer (α) and polymer (β) are present and that these materials may alternatively be present as a mixture, thus implying that a mixture need not be present. Finally, claims 1-17 are rejected as containing

new matter, it being alleged that the definition of $Mw_{30}(a)$ is new matter since this definition is not found in the specification as originally filed. Applicants respectfully submit that each of these rejections is moot in light of the amendments of claims 1 and 14 as indicated herein. Applicants point out that the amendment of claim 1 is made merely to correct the typographical error of reciting "$Mw_{30}(a)$" rather than "$Mw_{30}(A)$" as appropriate in the amendments of August 6, 2001. Claim 14 is similarly amended for purposes of clarity only. No change in any claim scope is intended by these amendments. In light of such amendments, Applicants respectfully submit that all claims are clear and indefinite.

Claim Rejections - 35 U.S.C. §§ 102/103

Claims 14-17 are rejected as anticipated by or, in the alternative, as obvious over Kawauzra et al. (U.S. Patent No. 5,679,744), for those reasons of record. It is alleged that Kawauzra et al. discloses a composition in which two different incompatible rubbers are blended with an AB block copolymer which is compatible with one rubber component and incompatible with the other (Office Action dated May 4, 2001).

Applicants respectfully disagree. Applicants point out that the present invention is directed to a rubber composition suitable for use in rubber parts such as tire tread and sidewalls and having improvements as to tensile strength, elongation and rubber resistance. For instance, in one preferred embodiment, the present invention is directed to a rubber composition comprising (i) an incompatible polymer blend comprising at least two diene rubbers selected from the group consisting of rubbers containing at least one conjugated diene monomer and, optionally, at least one aromatic vinyl monomer and forming two incompatible polymer phases (A) and (B) and (ii) 0.1 to 20 parts by weight,

based upon 100 parts by weight of the total polymer component including the block copolymer, of a block copolymer having at least two mutually incompatible blocks (a) and (b) in which the block (a) is compatible with the polymer phase (A) and incompatible with the polymer phase (B) and the block (b) is compatible with the polymer phase (B) and incompatible with the polymer phase (A), and comprising at least one conjugated diene monomer and, optionally, at least one aromatic vinyl monomer, wherein the polymers forming the polymer phases (A) and (B) satisfy the following equations (I) and (II):

$$Mw_{30}(A)/Mw(a) \leq 1.2 \qquad (I)$$

$$Mw_{30}(B)/Mw(b) \leq 1.2 \qquad (II).$$

(See e.g., claim 1).

In another preferred embodiment, the present invention is directed to a rubber composition comprising (I) 100 parts by weight of a block copolymer having at least two mutually incompatible blocks (a) and (b) and composed of at least one conjugated diene monomer and, optionally, at least one aromatic vinyl monomer and (II) 5 to 200 parts by weight of (i) a polymer (α) compatible with the block (a), (ii) a polymer (β) compatible with the block (b) or (iii) a mixture of the polymer (α) and the polymer (β), wherein the weight average molecular weights of the polymers (α) and (β) satisfy the following equations (III) and (IV):

$$Mw(\alpha) / Mw(a) \leq 1.2 \qquad (III)$$

$$Mw(\beta) / Mw(b) \leq 1.2 \qquad (IV)$$

(See e.g., claim 14).

It is therefore quite clear that the present invention relates to the compounding of a block copolymer having the specified relationship(s) as defined by equations (I), (II), (III)

and/or (IV) for the molecular weights between the matrix polymers and the corresponding block of the block copolymer. As noted above, such rubber compositions are improved as to tensile strength, elongation and abrasion resistance.

No such invention is taught or suggested in the prior art including the cited references. Applicants point out that Kawauzra et al. discloses a rubber composition comprising:

(i) at least one rubber selected from the group consisting of styrene-butadiene copolymer rubbers (SBR);

(ii) at least one rubber selected from the group consisting of styrene-butadiene copolymer rubbers (SBR) and/or polybutadiene rubbers (BR) which is incompatible with the above SBR component (i); and

(iii) an A-B type block copolymer composed of

- a block A comprising a styrene-butadiene copolymer (SBR) or polyisoprene (IR), and
- a block B comprising a styrene-butadiene copolymer (SBR) or polybutadiene (BR).

Kawauzra et al. teaches that block A is compatible with the SBR component (i) and incompatible with the SBR and/or BR component (ii), while block B is compatible with the SBR or BR component (ii) and incompatible with the SBR component (i). Kawauzra et al. also discloses two incompatible polymer phases, the reference teaching that the rubbers of (i) and (ii) are incompatible.

However, in contrast to the present invention, Kawauzra et al. contains absolutely no teaching or suggestion regarding the molecular weight distribution as defined by the

relationships of equations (I), (II), (III) and/or (IV). Applicants point out that the molecular weight distribution or relationships of molecular weight according to the present invention are able to provide for remarkable improvements in abrasion resistance as well as other physical properties for the resulting rubber compositions. Any such teaching or suggestion is completely absent from the cited Kawauzra et al. reference. Applicants note that Kawauzra et al. does discloses a process for producing the block A and the block B by ordinary methods, followed by coupling with a coupling agent. However, the reactivity or reacting ratio of the coupling reaction is not disclosed therein, and also, there is no disclosure that the specified parts of the block A and the block B are not coupled to terminate the reaction. It is therefore quite clear that the present invention including 100 parts of the (a) - (b) block copolymer (I) and 5 - 200 parts of the polymer (α) and the polymer (β) satisfying the equations (III) and (IV), according to claim 14, are neither taught nor suggested by Kawauzra et al. The rejection over the cited reference should be withdrawn.

Claims 1-17 are rejected as anticipated by or, in the alternative, as obvious over Zanzig et al. It is alleged that Zanzig et al. discloses a composition containing a blend of polyisoprene and polybutadiene to which an isoprene butadiene block copolymer is added as compatibilizer.

Applicants respectfully disagree. Zanzig et al. studies the effects of the addition of 1,4-polyisoprene-1,4-polybutadiene (IBR) block copolymers or polymer compatibility and vulcanizate properties of NR/*cis*-1,4-polybutadiene rubber blend. Zanzig et al. discloses the block copolymer as being prepared using unmodified *n*-butyllithium catalyst. Zanzig et al. also discloses the natural rubber as being No. 2 RSS, and that the natural rubber and

cis-1,4-polybutadiene are incompatible with each other.

However, Applicants point out that from the polymer characteristics in Table I at page 539 of Zanzig et al., the following characteristics can be calculated:

Block Copolymer No.		Mw (x 10^{-3})*1	Block IR*2 Mw (x 10^{-3})	Block BR*2 Mw (x 10^{-3})
-	NR	722	-	-
-	BR	533	-	-
1	80 - 20 IBR	306	245	61
2	80 - 20 IBR	373	298	75
3	80 - 20 IBR	516	413	103
4	50 - 50 IBR	449	225	224

*1: Calculated from Mn and Mw/Mn

*2: Calculated from the weight ratio of the blocks

It is to be noted that even though Mw_{30} values of NR and BR are not determined due to the absence of the molecular weight distribution curve, the relationships according to equations (I) and (II) cannot be considered satisfied. This is because the Mw of each block BR is too low in the block copolymers 1-3 and the Mw of each block IR is too low in the block copolymer 4. In addition, Applicants point out that the microstructure of the BR block portion of the cited block copolymer is about 90 mol% of 1,4-bond and about 10 mol% of 1,2-bond, wherein about 90 mol% of 1,4-bond is composed of trans-1,4/*cis*-1,4 of about 2/1, since n-butyl lithium is used as a polymerization initiator. It is therefore quite clear to those of ordinary skill in the art that this block is not compatible with the matrix polymer having a *cis*-1,4 content of about 98 mol%. The present invention clearly cannot be

considered anticipated or obvious over the cited reference.

In addition, Applicants note that it is alleged in the Office Action that it is known to those of ordinary skill in the art that a small amount of homopolymer is generated during alkyl lithium polymerization of diene monomers due to unwanted termination of the lithium chain and living polymer, and therefore all features of each of the claims are disclosed. However, Applicants respectfully point out that the present invention according to claim 14 is related to a composition comprising (I) 100 parts by weight of the (a) - (b) block copolymer and (II) 5 - 200 parts by weight of the polymer (α) and/or (β), and satisfying the equations (III) and (IV). Applicants also note that it is well known in the art that the homopolymer in a large amount corresponding to 5 parts by weight bonded upon 100 parts by weight of the block copolymer is not formed in a conventional alkyl lithium polymerization, unless part of the polymerization is intentionally terminated during the living polymer step. The block polymer of the cited reference is therefore quite different from that of the present invention. Applicants again respectfully request withdrawal of all rejections, as it is clear that the present invention is not anticipated by or obvious over the cited reference.

Applicants respectfully urge that in light of the discussion above, the claimed invention is in condition for allowance and request early notification to that effect.

If for any reason, the Examiner feels the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, Applicants' undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

In the event this paper is not considered to be timely filed, Applicants hereby petition for an appropriate extension of time. The fee for this extension may be charged to our Deposit Account No. 01-2300, along with any other fees which may be required with respect to this application.

Respectfully submitted,

Hans J. Crosby
Attorney for Applicants
Reg. No. 44,634

Atty. Dkt. No.: 108218-09004
Customer No. 004372
ARENT FOX KINTNER PLOTKIN KAHN PLLC
1050 Connecticut Avenue, N.W.
Suite 400
Washington, D.C. 20036-5339
Tel (202) 857-6000
Fax (202) 638-4810
Enclosure: Marked-Up Copy of Claim Amendments
HJC/ejb

MARKED-UP COPY OF CLAIM AMENDMENTS

Claim 1. (Amended) A rubber composition comprising (i) an incompatible polymer blend comprising at least two diene rubbers selected from the group consisting of rubbers containing at least one conjugated diene monomer and, optionally, at least one aromatic vinyl monomer and forming two incompatible polymer phases (A) and (B) and (ii) 0.1 to 20 parts by weight, based upon 100 parts by weight of the total polymer component including the block copolymer, of a block copolymer having at least two mutually incompatible blocks (a) and (b) in which the block (a) is compatible with the polymer phase (A) and incompatible with the polymer phase (B) and the block (b) is compatible with the polymer phase (B) and incompatible with the polymer phase (A), and comprising at least one conjugated diene monomer and, optionally, at least one aromatic vinyl monomer, wherein the polymers forming the polymer phases (A) and (B) satisfy the following equations (I) and (II):

$$Mw_{30}(A)/Mw(a) \leq 1.2 \qquad (I)$$

$$Mw_{30}(B)/Mw(b) \leq 1.2 \qquad (II)$$

wherein $\underline{Mw_{30}(A)}$ [$Mw_{30}(a)$]: a value of molecular weight corresponding to 30% of the cumulative area when converting the curve of the distribution of the molecular weight measured by GPC to the integrated molecular weight curve of the polymer forming the polymer phase (A),

Mw30(B): a value of molecular weight corresponding to 30% of the cumulative area when converting the curve of the distribution of the molecular weight measured by GPC to the integrated molecular weight curve of the polymer forming the polymer phase (B),

Mw(a): weight average molecular weight of block (a) of block copolymer, and

Claim 14. (Amended) A rubber composition comprising (I) 100 parts by weight of a block copolymer having at least two mutually incompatible blocks (a) and (b) and composed of at least one conjugated diene monomer and, optionally, at least one aromatic vinyl monomer and (II) 5 to 200 parts by weight of (i) a polymer (α) compatible with the block (a), [and] (ii) a polymer (β) compatible with the block (b) [and/or] or (iii) a mixture of the polymer (α) and the polymer (β), wherein the weight average molecular weights of the polymers (α) and (β) satisfy the following equations (III) and (IV):

$$Mw(\alpha) / Mw(a) \leq 1.2 \qquad \text{(III)}$$

$$Mw(\beta) / Mw(b) \leq 1.2 \qquad \text{(IV)}$$

wherein Mw(α): weight average molecular weight of polymer (α),

Mw(β): weight average molecular weight of polymer (β),

Mw(a): weight average molecular weight of block (a) of block copolymer, and

Mw(b): weight average molecular weight of block (b) of block copolymer.